IEEE SOCIETY ON MICROWAVE THEORY AND TECHNIQUES

NEWSLETTER

EDITOR: Nat Pelner

Hughes Aircraft Co., Missile Engineering Labs, Canoga Park, California 91304

Number 83, Summer 1976

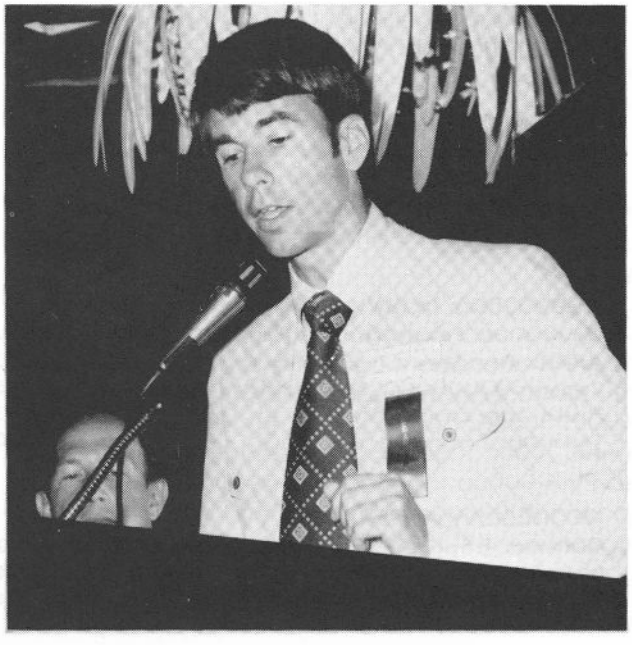
'76 AWARDS BANQUET

The Annual Awards Banquet was held on June 15 in the Starlite Ballroom at the Cherry Hill Inn in Cherry Hill, N.J. The banquet was a sell out due in large part to the featured Speaker, Astronaut William D. Lenoir. Dr. Lenoir described the technical aspects of the Space Shuttle Program and he also discussed our future in space.

Highlighting the evening were the award presentations. The Microwave Prize was presented to T. E. Rozzi and W. F. G. Mecklenbrauker, H. J. Riblet received the Microwave Career Award, and J. F. White received the Microwave Applications Award.

Outgoing ADCOM President, Warren Cooper received the traditional pin from the current ADCOM President, Pete Rodrigue.

B. D. DeMarinis, Symposium Steering Committee, served as M. C. and Stand-up comedian. A grand time was had by all.

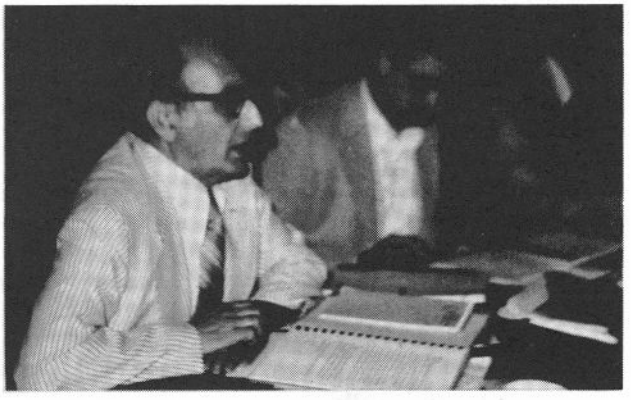


The banquet speaker Astronaut Lenoir

FLORIDA AND WASHINGTON DC SELECTED TO HOST THE 1979 AND 1980 SYMPOSIUMS

At its June meeting MTTS-ADCOM selected Orlando, Florida as the site for the 1979 Symposium site. An outstanding proposal was presented by Rudi Henning. Those of us who know how Rudi operates, know that this will be a well run symposium.

Boris Sheleg of the Washington D. C. MTTS Chapter presented a succinct proposal for the 1980 Symposium.



Rudi Henning giving his Symposium Pitch

Bernie DeMarinis kept us laughing

PRESIDENT'S MESSAGE

by Pete Rodrique

The "Bicentennial Symposium" was unquestionably a success. While statistics are not yet complete, it appears that total registration was near 700, and technical sessions were well attended. In fact, many engineers were not completely satiated by the three day meeting and stayed over for a fourth day of workshops. The Table below summarizes session attendance figures based on an unofficial, and rather random sampling. The Wednesday "low technology" sessions on markets, TF&A, and Government Laboratory activities had a high level of interest, especially in view of the fact that they did occur on the last day. It would be interesting to ascertain the number of individuals who came specifically for those sessions.

There is some perception that the Symposium has too many parallel sessions. But the alternatives (reject more papers or run an official four day symposium) are not attractive to large segments of MTT. Hal Sobol has been asked to formulate recommendations along the lines or reducing the number of parallel sessions. If anyone would like to make suggestions to Hal, he can be reached at Collins Radio in Dallas (214) 690-5881 x3463.

The exhibits were more numerous than ever before, and seemed to attract a healthy interest among engineers. ADCOM is embarking on the professional management of exhibits. It is hoped that the delicate balance between technical symposium and exhibition can be maintained. We've not had much feedback from you on this matter, and ADCOM would like some expression of opinion from the membership on this venture.

The September Meeting of ADCOM features the election of ADCOM members and officers. Hal Sobol is heading the nominations committee, and local chapters are invited to nominate individuals as detailed elsewhere in this issue.

The experimental page charge program for the MTT Transactions has been brought about by recent fiscal pressures. It is essentially a policy like that used by publications of the American Institute of Physics. Papers submitted for publication are reviewed as in the past for technical merit. Once a paper has been accepted for publication, the author is informed of such acceptance and asked (in a separate letter from the Business Editor) to indicate whether or not he (or his organization) will honor the voluntary page charge. Those responding affirmatively will have their papers published in the next issue sent to the printer (allowing for theory/applications distinctions). Those responding negatively will have their papers printed as soon as space is available in the "free quota."

The free quota is established by the guideline that free pages in each issue of the Transactions can not exceed a fixed percent of the total pages in that issue. To date we have not had sufficient experience to tell what sort of waiting period (if any) will develop for quota papers.

The need for this system is brought about by the fact that Transactions costs are such a major fraction of our budget that relatively minor changes in page charge returns can have a devasting effect on our total budget. Thus the system is being tried in an attempt to establish a firm base of page charge support that can be reliably budgeted.

It is not a mandatory page charge system, just somewhat "less voluntary".

TABLE OF ATTENDANCE

MONDAY MORNING	
Introductory Session and Review of Optical Fibers	~330
Integrated Optics and Fiber Optics	~ 50
SS Microwave Sources	~180
Passive Microwave Components	~110
MONDAY AFTERNOON	
Microwave in Communication Systems	~ 70
L. N. Receivers and S. S. Power Amplifiers	~190
Filters	~ 40
TUESDAY MORNING	
Microwave High-Power Techniques	~ 60
Gigabit Logic	~ 50
M. M. and Microwave Integrated Circuits	~100
TUESDAY AFTERNOON	
CAD and Meas. and Microwave Meas. and Technology	
M. M. and Sub M. M. Wave Technology	
Ferrite Components	~ 45
SAW Resonators	
WEDNESDAY MORNING	
Joint Invited: Future Microwave Markets	~220
Acoustic Wave Devices and Techniques	~ 45
Commercial Applications and Techniques	~ 45
Phased-Array Components	~ 55
Technology Forecasting	~150
WEDNESDAY AFTERNOON	
Microwave Activities in Government Laboratories	~160
Biological Effects	~ 34
Electromagnetic Theory	~ 44

CHAPTER ACTIVITIES

by Dick Sparks

The annual meeting of the Chapter Chairmen was held on Sunday evening June 13 at the 1976 Symposium Site, and was well attended with representatives from fifteen of the chapters present. A recently updated version of the Check List for Chapter Officers was used as a basis for the main discussion and several current problems were probed in some depth. Money and meeting places were two of the more significant problem areas discussed. Some Chapter Officers are experiencing financial difficulties in generating local technical programs, one day seminars and lecture series. It should be understood by all Officers that their local IEEE Section is the primary source of funding for all Chapter technical activities. A reasonably well planned budget with anticipated income and expenses for a local seminar or lecture series when submitted to the local section should receive a positive response of advanced funding in most cases. In general, these events should be planned as self supporting activities based on a minimum break even attendance projection. A new edition of the "One Day Seminar" brochure is scheduled for release very shortly and copies will be mailed to all Chapter Chairmen. Further details on financial planning are contained therein.

Some chapters are having difficulty finding suitable meeting places for their monthly technical programs. This problem offers an interesting challenge and requires some ingenuity that varies with the location. Chapters located in areas with significant microwave activity are frequently able to find local industry support in providing a meeting room and visual aids. Those groups not as favorably disposed have found suitable facilities by holding their meeting in the function room of a local restaurant where they have their premeeting dinner.

I would like to hear from any Chapter that is consistently having difficulty in either of the above areas.

New speakers lists will be mailed to each Chapter Chairman by Steve Temple, Chapter Records Chairman. Nearly every microwave topic of interest is covered in this tabulation. The Program Chairman of each Chapter should consider contacting the FY 1977 MTT S National Lecturer, Dr. Fred Sterzer of RCA Corporation whose topic is "Microwave Solid State Devices." His address and phone number were published in the Spring Newsletter and may also be found in the MTT S Directory. Plan to have your technical programs at least tentatively scheduled for the entire year by early September and please send copies of your meeting reports to Steve Temple, Raytheon Company, Bedford, Mass., 01730.

ADCOM HIGHLIGHTS

by Larry Whicker

The June 13 ADCOM meeting was held at Cherry Hill, New Jersey. A large part of the meeting was devoted to presentations from the meeting and symposia committee and in particular to presentations on future symposia site selections. The Seattle Chapter and the combined Florida/West Coast-Orlando chapters made proposals for the 1979 symposium. Both groups made excellent proposals with the Florida Chapters being selected. Seattle was encouraged to bid again for a future meeting. The Washington DC Chapter submitted, and had approved, a letter proposal for the 1980 symposium site. After expressing interest, the Los Angeles Chapter was encouraged to prepare a proposal for a Joint AP-MTT symposium for 1981 for presentation at the next year's June ADCOM meeting. Other important topics included reviews of the Transactions, the Societies financial status, and possible upcoming modification of the IEEE's organizational structure.

Pete Rodrigue, ADCOM President, presided over the 10:30 AM - 6:30 PM meeting. President Rodrigue reviewed the overall program of finances within the IEEE. He reported that the Power Society, with 23,000 members, has been made a Division of the IEEE. This results in seven Divisions of about equal size. Additional items reported by President Rodrigue are:

A. A group from Princeton, New Jersey have submitted a petition to form a joint ED-MTT Chapter.
B. Don Parker has replaced Bill From as an MTT representative on the Solid State Circuits Council.
C. Pete Rodrigue, on behalf of ADCOM, has approved a $500.00 advance to Submillimeter meeting.
D. Harold Stienhelfer has been appointed to the Continuing Education Committee.

MTT TRANSACTIONS – D. Parker

Editor Don Parker submitted a comprehensive report on the Transactions status for the entire year. Several interesting points were made during discussion of the Transactions: It was pointed out that MTT Transactions is receiving excessive editorial expenses resulting from major author modification to galley proofs of accepted paper. A motion submitted by Warren Cooper stating that excessive author modification at the galley proof stage be billed directly to the author. After discussion, this motion was passed unanimously. Don Parker submitted a motion stating that beginning in January 1977 biographies of authors of short papers be included in the Transactions - after discussion this motion was passed unanimously also.

Business Editor Jim Degenford reported that the percentage of page charges honored for the first few months of 1976 are: February; 29%, March; 56%, and April; 48%. Jim reported that he is working with IEEE Headquarters in order to make collection of page charges more efficient.

Hal Schrank reported that he has been quite successful in obtaining eleven new institutional listings. These have been obtained through personal contact.

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FINANCE COMMITTEE – G. Oltman

Chairman George Oltman presented the 1975 financial statement of the MTT. A summary of his findings are:

1975			
	Projected	Actual	Derivation
Total Income	179.4 K	237.5 K	58.1 K
Expenses	185.0 K	220.8 K	35.8 K
	5.6 K	+16.7 K	22.3 K

Director Robert Rivers proposed a $2.00 increase in MTT dues to allow for further inflation in printing costs. After discussion, a $1.00 increase for 1977 was agreed on.

MEETING AND SYMPOSIA – K. Button

The next agenda item meetings and symposia took up most of the meeting:

- 1976 Symposium – M. Caulton and B. Demarius

It was reported that an outstanding advance registration (331) had been obtained with over 470 hotel rooms sold out. (Final attendance was 687). They reported that 36 booth rentals had taken place.

- 1977 Symposium – D. Rubin

Dave Rubin reported that plans for the symposium were coming along quite well with the first major Program Committee meeting to be held at Cherry Hill. Dave reported that the meeting space was being cramped somewhat by the space requirements of the contract exhibitor for the meeting. After reviewing the space problem, it was decided to go along with the space allocations worked out previously by ADCOM, Dave Rubin and Horizon House.

- 1978 Symposium – K. Button

Ken Button reported for Bill Steenaart. Ken reported that he and Howard Ellowitz will go to Ottawa in late June to review the meeting and exhibit facilities.

- 1976 Submillimeter Meeting – K. Button

Ken Button reported that there will be twenty-one invited speakers and about one-hundred contributed papers.

- Symposia Exhibits Contract – L. R. Whicker

Larry Whicker reported that a draft contract between ADCOM and Horizon House has been drawn and is presently being reviewed by the IEEE legal staff.

- Future Symposia

Proposals for 1979 were presented by Rudi Henning for Florida and by Jim Lambert for Seattle. The Seattle proposal was a joint MTT-AP-URSI-Bio Effects meeting. Both proposals were truly outstanding. Jim Lambert reported one problem area for the MTT-Seattle meeting - that being only two-hundred - four-hundred hotel rooms. After Florida was selected in a close vote, ADCOM encouraged Seattle to bid again.

A single letter proposal for 1980 was presented by Boris Sheleg, Chairman of the Washington MTT Chapter. The proposal was accepted with the proviso that a full proposal-report be submitted to the September ADCOM meeting.

Al Clavin indicated that he had been selected as chairman of a proposal effort for the 1981 Symposium in the Los Angeles area. The proposal will be submitted to the June 1977 ADCOM meeting. Al was encouraged to investigate the possibility of a joint AP-MTT Symposium for 1981.

IEEE COUNCILS AND COMMITTEES – COMAR

Bill Guy reported on the activities of COMAR. Some of the items covered include:

- A reprint volume entitled "Biological Effects in Microwaves" is nearing completion.
- COMAR is compiling information on federal funding in research on biological effects of nonionizing electromagnetic radiation.
- COMAR has requested data on the reported Radiation of the American Embassy in Moscow.

Bill reported that the next COMAR meeting is scheduled in October at the URSI-AP meeting.

– TECHNOLOGY FORECASTING

Al Clavin reported that the MTT activity in Technology Forecasting was proceeding with a session of the Cherry Hill Symposium being devoted to this topic.

OPERATIONS – H. W. Cooper

Bylaws Lamar Allen presented a proposed change in Bylaws which will allow for improved operating efficiency. The proposed Bylaw change would require the Awards Committee to be chaired by an IEEE Fellow and the term would normally be for longer than one year.

Awards Warren Cooper reported that the Awards Committee had reviewed nineteen Fellow candidates and about half of these were recommended and are active MTT members. This was about the same percentage as last year. Warren Cooper and John Horton are presently asking for nominations for the various awards for next year. These are due in September.

STANDARDS CO-ORDINATING COMMITTEE - S. Adams

Steve Adams reported that the Waveguide Committee and the Magnetics Committee are quite busy. In particular, Steve reported that Hal Schrank has been able to break the log jam that has held waveguide standards for several years.

TECHNICAL COMMITTEES – H. Sobol

Hal Sobol reported that two committees are having Workshops following the MTT Symposium. He further reported that three committees are having a luncheon to discuss future Workshops.

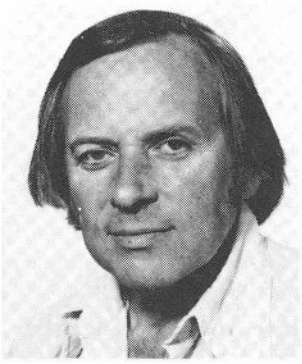
MEMBERSHIP SERVICES – R. Sparks

Dick Sparks indicated that a Chapter Officers ADCOM meeting is scheduled later in the day. G. R. Thoren presented a comprehensive report on membership growth and decline in the MTT. He outlined a program to obtain new members including sending a letter to each Transactions author who is not an IEEE and MTT member. He further described a program to recruit student members and to convert ex-student members to full members. Steve Temple reported that he is attempting to improve the chapter reporting procedure. He indicated that only 17% of the chapters are reporting on a regular basis. Further, he reported that he is working on an updated speaker's list for submission to the chapters.

LONG RANGE PLANNING – L. R. Whicker

Larry Whicker reported on the IEEE Long Range Planning Report. He indicated that Dr. John Zaborsky, Chairman TAB Planning, has prepared a reorganizational plan for the IEEE. TAB will take action on the plan in September.

The meeting was adjourned at 6:30 P.M. by President Rodrigue.



EDITORS NOTES

by Nat Pelner

The annual event, MTT International Symposium is over. In addition to a scientific learning process, it is a time when each of us renew old acquaintances and a time to make new ones. When all is said and done, we Microwavers are a resonably small closely knit group. Kudos to the Steering Committee and all who took part in it for it was a very successful and enlightening experience.

Two other annual events are about to take place, MTT-ADCOM Elections and the IEEE Presidential Election. ADCOM nominations are addressed elsewhere in this issue.

This year again we have a choice for the president and now a choice for vice-president also.

Last year even with a choice of candidates only one-third of the membership voted and about 31,000 votes determine who will direct the Institute for 155,000 members. Not only was this a sad commentary on the way we professionals respond, but more important than that, we are selling ourselves short. We are selling ourselves short because we allowed a small minority to elect the top officers of the Institute who will influence the direction that our professional society will take.

While the president's term is only for one year, he can determine the direction of the Institute for many years to come.

In this issue we are publishing statements from the candidates so that, in advance of the ballots, you can "look them over".

"Your responsibility as a voting member of IEEE is to be informed about the candidates, review what they have done for the IEEE, review their experiences that would help them lead the IEEE, evaluate the value of their own careers in providing IEEE with the leadership it needs. Finally your duty is to cast your ballot for the candidate of your choice".

MEMBERSHIP IS IMPORTANT

by Glenn Thoren

The membership campaign is continuing to take shape. A status report was presented (to the MTT S ADCOM meeting) at the MTT S International Symposium in Cherry Hill. The layout for an MTT S enclosure in the August mailing by IEEE to student branches is being completed. Few societies take advantage of this promotional mailing to student branches. Hopefully, we will achieve results.

Very few letters voicing the concern of the chapters about IEEE and MTT membership have been received. Members and officers; TAKE TIME TO WRITE! Membership is the responsibility of all members. The good news and successes of your chapter as well as the serious concerns will help to direct the future of this membership campaign. The opinions of the members and officers should be a key force in membership campaigns. Take time to write! The highlights of the comments received will be reported.

Be sure to discuss your chapters plans for membership at the next meeting!

Glenn R. Thoren, Membership Subcommittee Chairman
Raytheon MSD, Hartwell Road, C-58, Bedford, Ma - 01730

CALL FOR NOMINATIONS TO ADMINISTRATIVE COMMITTEE

Notice is hereby given to all members of the IEEE Society on Microwave Theory and Techniques that nominations for the Administrative Committee are now open and will be received on or before the annual meeting to be held on September 13, 1976 at the Los Angeles Wescon Show. Nominations can be made through any member of the Administrative Committee (see 1976 committee directory for names and addresses) or by petition signed by 25 members of the Society. Petitions should be submitted to the Chairman of the Nominations Subcommittee,

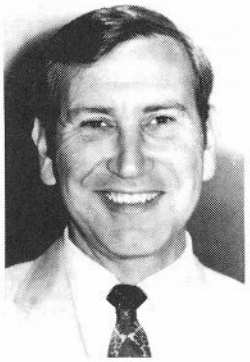
H. Sobol, Collins Radio Group
1200 N. Alma Rd.,
Richardson, Texas

The members of the Nominating Subcommittee are:

H. Sobol, Chairman
Harlan Howe
H. J. Kuno
J. H. Battocletti
David Rubin
Richard Snyder

Hal Sobol deep in thought about an ADCOM problem, "Will this new hair tonic work".

T. E. Rozzi accepting the Microwave Prize for himself and W. F. G. Mecklenbrauker



TECHNOLOGY FORECASTING AND ASSESSMENT

Panel Discussion Held at 1976 MTTS International Symposium

by Al Clavin

The IEEE has been interested in technology forecasting and assessment about the last five years and is encouraging groups and societies to participate. The objective has been to help the individual engineer with career planning as well as broader aspects such as sales and marketing information. The Society on Microwave Theory and Technique has endeavored to participate in this IEEE activity by sponsoring sessions of invited speakers on topics of current interest at their international symposium. This activity has been planned for three individual years, this present session being the third year.

The following is a summary of the speakers, subject matter, as well as questions and answers brought up by the audience.

Technology Forecasting of Solid State Microwave Generation and Application

T. A. Midford
Hughes Aircraft Co.
Torrance, Ca

DIGEST ABSTRACT

During the 13 years since J. B. Gunn's first observation of bluk electrical instabilities in gallium arsenide and indium phosphide, the technology and applications of active microwave solid state devices have advanced rapidly. Currently, development in this field is entering a phase which is highly materials-and-process intensive. Relatively simple structures such as IMPATT and Gunn diodes are being challenged by both bipolar and field effect transistors at frequencies through 20 GHz. The performance of these three terminal devices is in general superior to that of diodes. Along with, and partially as a consequence of this improved performance, increasingly stringent demands are being placed on materials and device processing technology. How well these demands are met will have a substantial future impact on performance, yield (and hence cost), and reliability as well as the rate at which further advances are made.

Significant trends which will be examined include: (1) the rapid increase in the development effort applied to III-V materials and devices, (2) problems and limitations of conventional processing and the degree to which solutions will be provided by machine processing (such as ion implantation and electron beam lithography), and (3) the increasing importance of realibility assessment at an early stage in device development. The economic implications of these trends will also be projected.

COMMENTS

In the past year new device technology has not progressed much with the exception of FET devices at X band and above. The III-V compounds such as IN AsP, In GA As, Ga In Sb, and Ga A1 As show much promise because of the larger peak to valley ratios, greater mobility and higher velocity fields. These are offset by the state of the art infancy of the materials.

The processing tools for Si and Ga As are well understood but not for the III-V compounds because very little work is being done in this area.

Q. Are oxide passivation techniques here so we can reliably put chips onto circuits?

A. Ga As – No
Si – Yes
Other Materials – No

Q. What do you see in the future for high power sources?

A. High peak low average (1% duty) power devices are here now. We are working on high duty devices such as Si double drift, TRAPPATs and some Gunn devices to 50W peak with high duty.

Q. What is the future for bi-polar devices to 18 GHz.

A. Similar to 10 GHz, only better.

Millimeter-Wave Integrated Circuits

H. J. Kuno
Hughes Aircraft Company
Torrance, California

DIGEST ABSTRACT

Approaches to the development of millimeter-wave integrated circuits may be classified into two basic types, viz., the extension of the microwave integrated circuit techniques (stripline/microstripline circuits) and the integrated optics techniques (dielectric/image guide configurations). In this paper various approaches are reviewed and their capabilities and limitations as applied to active millimeter-wave multifunctional integrated circuits are compared.

COMMENTS

The advantages of using millimeter waves in radars and secure communications was addressed, in particular, size, broad bandwidths and light weight. In the 1980-1990 period, a significant growth in secure communications and radar is forecast.

The future of millimeter wave systems is dependant on the increased use of integrated circuits. The need is here, its feasible, but not quite ready. The obvious advantages to using integrated circuits are size-weight reduction, reduced fabrication costs but performance needs improvement.

Q. Many non integrated circuits use packaged devices. This appears to be a step backward. Can we use beam-lead devices.

A. It will be in the future.

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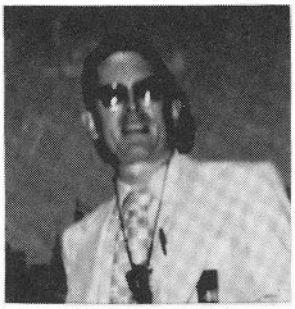


Technology Projections for Microwave Subassembly

N. Jansen
Microwave Associates
Burlington, Massachusetts

DIGEST ABSTRACT

During the past decade, microwave subassembly packaging techniques have evolved from the single component level to a high degree of sophistication. In the years ahead this trend can be expected to continue with some modification of direction. The areas of most probable growth are:

1. Increased application of multi-media techniques incorporating newer elements such as slot lines, saw, ferrite substrates and the long forecasted monolithic MIC.
2. A higher level of active element integration.
3. An increased level of activity at frequencies above 20 GHz.
4. A greater use of lumped element circuits at frequencies below 20 GHz.
5. Continued and increased pressure to reduce costs.

These factors will be discussed in the light of present technology.

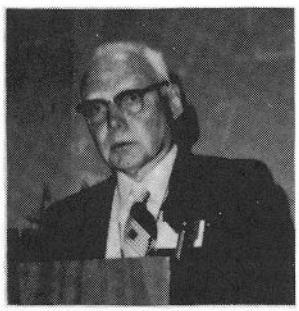
COMMENTS

N. Jansen, Microwave Associates substituted for H. Howe.

Mr. Jansen annotated the history of microwave packaging through to the present microwave integrated circuits. He showed how impact extrusions can be used to reduce cost. He showed integrated circuits with ferrites and garnet substrates as well as alumina substrates. In addition the use of fused silica as a substrate up to 90 GHz was addressed. One of its advantages is its low temperature coefficient.

He described a Ka band "Waveguide Integrated package" (WIP). This package consists of a complete waveguide network. The circuits are milled out of a single solid metal block which makes three of the waveguide walls with a cover making the fourth wall.

Mr. Jansen described the module concept where smaller sealed microwave modules were combined on a "Mother" substrate to make a major assembly. The questions centered around the details of this construction.



Free Space Power Transmission and Applications – Present and Future

W. C. Brown
Raytheon Company
Waltham, Massachusetts

DIGEST ABSTRACT

The technology for the transmission of power through free space by means of microwave is defined to include both the highly collimated microwave beam and the interconversion of ordinary electrical power and microwave power at both ends of the system. Using this definition, the overall system efficiency (DC in to DC out) has recently been increased by NASA-supported technology developments to a certified 54%. Other technology developments have been set into motion which will further increase the overall efficiency and greatly increase the power handling capabilities of these systems.

The nature of the applications of this technology and the speed with which it will be accepted, will depend upon a variety of factors which would include: long-term national and world-wide energy requirements which could initiate systems to transmit electrical power derived from the sun in space to the earth; a limited but possibly real need for a continuous supply of weightless "fuel" to airborne vehicles of various kinds; and upon the growth burden being placed upon conventional electrical power generation and transmission systems in today's limited resource environment by their heavy dependence upon heavy rotating machinery, use of massive amounts of ordinary and critical materials, and the job-shop and construction-site nature of much of their means toward future expansion. By contrast, no investment in a transmission medium, long life components with no rotating parts, minimal material mass requirements in system components, and the economy of mass production of simple, light-weight components are intriguing characteristics of the microwave power transmission system.

COMMENTS

The essence of this technology is to capture the sun's energy in a satellite in equatorial synchronous orbit and then to send the power to earth by a multigigawatt microwave beam.

The present overall DC to DC efficiency is in the order of 55% with the combined transmission, collection and rectification efficiency of approximately 78%.

The system is conceived to use a satellite which will carry a large waveguide slot array. An Amplitron or continuous-cathode cross-field amplifier is proposed to generate the high microwave power. At present the efficiency of the Amplitron is as high 80%. It is probable that 85% efficiency will be acheived.

TABLE I. MICROWAVE POWER TRANSMISSION EFFICIENCIES AT 2.45 GHz

	Efficiency Presently Demonstrated	Forecast before 1981		Forecast before 1986	
		90% Confidence	50% Confidence	90% Confidence	50% Confidence
Microwave power generation efficiency. *	76.7%	83%	89%	89%	92%
Transmission efficiency from output of generator to the collector aperture.	95%	96%	96%	96%	97%
Collection and Rectification Efficiency (Rectenna)	82%	87%	90%	91%	93%
Overall Efficiency **	54%	71%	75%	77%	80%

* This efficiency assumes that the generator has a pure-metal secondary emitting cathode surface for long life.

** These are efficiencies under laboratory conditions. A transmission efficiency of 97% in a practical system is probably not economically attractive.

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Table 1 is a forecast of the power transmission efficiencies.

Free Space Microwave Power Transmission System experiments at JPL's Goldstone facility were described.

A copy of Mr. Brown's talk is available by writing to:

William C. Brown
Raytheon Company
Waltham, Ma 02154

Q. What about diode failures ?

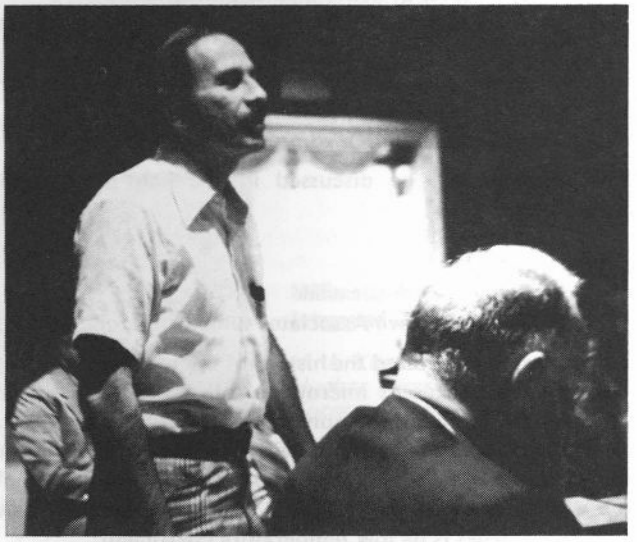
A. Over 800,000 diode hours – corresponding to 4,000 hours of operation have been accumulated. Since the first 150 hours of operation, only five diodes have failed, four of these failures occurred simultaneously under high overload caused by operator error.

Q. Did rain affect the Goldstone experiment?

A. Rain or other atmospheric conditions did not cause any problem.

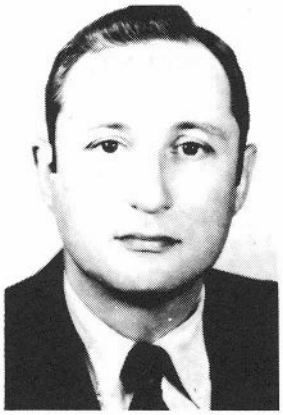
Pete Rodrique receiving "advice" from Warren Cooper

Al Clavin Addressing the Attendees at the Technology Forcasting and Assessment session



Marty Caulton telling ADCOM how great the Symposium will be

Steve Adam said, "Oh yeah! We'll see"



NEWS FROM TAB

by R. D. Briskman

Dear Microwave Theory & Techniques Society Member,

This is my second letter for the purpose of sharing with you some of the more important planning, actions and events which have recently occurred in the Technical Activities Board of the Institute. It should be mentioned that my previous letter of March 12 was published generally three months later, making the information less current than desired, and that my solicitation for your views on the several significant matters covered therein did not evoke many responses. Again, your views on matters discussed in this letter, as well as any others, would be appreciated.

One important matter involves organization. A plan for a new IEEE organization was issued by the Institute's Long Range Planning Committee (LRPC) late last year. This plan was distributed and analyzed by TAB (Technical Activities Board comprising the 33 Societies, Groups and Councils, the Standards Board, the Technical Committees, etc.). The TAB Planning Committee has generated a recommended variant of the LRPC plan which organizes the appropriate IEEE technical elements in a common structure, eliminates one administrative level, permits adequate representation of technical interest at Board of Director levels, ensures policy review by operational officers and reduces the current administrative burden on the TAB Chairman. The TAB plan has been sent to your Group/Society Officers, and a copy can be obtained from them.

The second matter concerns finances, which were briefly discussed in my last letter. We are currently constructing the Institute's 1977 Budget. It is impossible to continue all current programs of the Institute without either having a dues increase or incurring a substantial deficit. This is due almost solely to inflation. Also, several attractive new programs have been proposed which would require additional funds for implementation. The present fiscal effort is directed at reducing current programs to achieve a "break-even" budget in 1977 without raising the Institute's general dues. Even if this effort is successful for the 1977 Budget, such a modus operandi could not be pursued indefinitely. Also, several of the Groups/Societies are planning to make small increases in their individual fees for 1977 to cope with specific financial situations.

The last matter involves new activities. Several come to mind. The Energy Committee issued a letter last month on the California Initiative (dealing with the use of Nuclear Power in that State) to our members there. The letter offers to send the members literature, both pro and con, concerning this matter. A second item is our starting an investigation of the feasibility of IEEE forming a candidate Technical Qualification Review Panel for appointments to Federal Regulatory Commissions within our field of expertise, such as is done by the American Bar Association for the Supreme Court. Another important matter is the generation of a policy statement on operation of our Technical Committees which will ensure conformance to anti-trust regulations. This statement is currently being published. Lastly, progress has been made in creating a TAB technical entity dealing with cable television (CATV) technology and in expanding our role in oceanographic electronics.

At the halfway mark of 1976, it appears TAB should have a year marked by progress and accomplishment. Credit for this lies with the Administrative Committee and Officers of your Group/Society and with you. I wish to convey my thanks and appreciation for these efforts to them and to you.

Sincerely,

Robert D. Briskman
Vice President, Technical Activities
Chairman, Technical Activities Board

PICTURES FROM THE BANQUET

Pete Rodrigue letting it all hang out

Mr. and Mrs. Marty Caulton enjoying themselves before dinner

Marty after dinner

STATEMENTS OF THE CANDIDATES

R.A. Rivers & C.A. Bayless

Rivers

Bayless

We believe that the IEEE membership should have a choice of candidates on the ballot, and that the choice should be based upon the issues. Furthermore, the candidates should be chosen on their ability to effectively address the issues. Our success in promoting members' professional needs as members of the Board of Directors shows our ability. Our combined Technical, Regional and Professional backgrounds provide experience and concern about all of the problems and interests of the Institute.

Major Areas and Detailed Programs Supported:

1. Enhancement of the Technical Interests of the Members:

   Maintain high-quality refereed journals, aggressively develop coverage of new fields, promote refereed publication of summaries of body of knowledge and increase membership recruitment effort so IEEE will represent an even larger segment of the EE profession.

2. A lifetime engineering career with adequate compensation:

   Eliminate age discrimination in engineering employment by lobbying for pertinent legislation, improve employed-engineer rights on government contract termination, obtain fringe benefit continuity and better pension coverage through lobbying, implement IEEE Employment Guidelines by determining employer practices and make information available to the members, set up and operate an ethics review board, support legal expenses for test cases of unfair practices under the Guidelines, and obtain permanent science and engineering advisory activity on the White House Staff.

3. Substantial support for the role of engineering in solving society's problems:

   Obtain adequate research funding, provide technical support to lawmakers at federal, state, and local levels; obtain funding for engineering-oriented public programs, and establish ethical responsibility in eyes of public.

4. Regulation of the quality and quantity of engineers in the profession with due consideration for existing practitioners:

   Publicize the EE career situation "like it is," gain acceptance that an engineering shortage does not exist, eliminate false recruitment advertising by educational institutions through accreditation reviews, require educational systems to educate for the careers that actually exist or can realistically be expected, limit accreditation of engineering schools to those needed, eliminate special treatment for immigrant engineers, and obtain requirement for a manpower impact statement for any government action affecting the supply-demand.

5. A positive incentive system for significant new contributions:

   Obtain improved patent legislation through lobbying, obtain employed-inventor mandatory royalty rights, and obtain property rights for research results.

6. A work environment that provides a positive incentive and an opportunity to maintain technical proficiency:

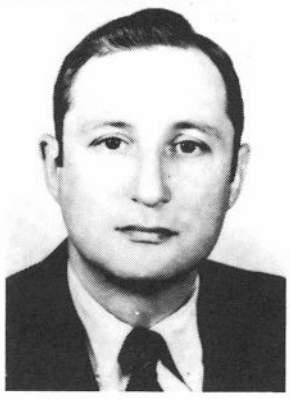
   Obtain continuing education through job assignment, and obtain full employer financing of continuing education.

7. Peer recognition for the complete spectrum of professional contributions:

   Commission articles to be written about contributions and contributors in technical publications and in the public press, the increase coverage of application-oriented accomplishments.

R.M. Saunders & R.D. Briskman

Saunders



Briskman

As the nominees of the Board of Directors, we are pledged to carry out responsibly the policies of the Institute members who have elected the Board. The Institute must continue to stress its traditional excellence in technical affairs, publications and standards. We should continue to develop our educational programs, our professional affairs, and improve our local activities.

In the area of technical affairs, we must:

- Urge our colleagues to examine the technical base currently encompassed by the various groups to embrace recent and future changes in technology.
- Expand our technological standards activities even more to respond to national and international needs.
- Add substantially more application oriented activities to our current technical efforts and in our publications.

In the area of publications we must strive to:

- Make technical information available faster and with less expense.
- Implement the computer-aided selection of individual articles.
- Develop a section in Spectrum devoted to timely news about the IEEE, its members, and the profession.
- Maintain quality in the face of rapidly rising costs.

In educational affairs we must do all we can to:

- Develop strong continuing education programs.
- Make the programs portable in the sense that delivery may occur anywhere in the world and credit and recognition for educational achievement be transferable anywhere in the world.
- Tap the expertise of the Groups and Societies to assure the quality of the educational programs.
- Encourage employers to establish the climate whereby our members can maintain their technological capability so as to assure our members of a beneficial lifetime career.

In regional affairs we must do all we can to:

- Bring technical innovation and knowledge to the home base of the individual.
- Enhance the Group/Society Chapters in the local section. Develop a sense of obligation on the part of our Groups and Societies to interpret technological development for our members in their locale.
- Assure the financial viability of our sections. Recognize that our overseas sections and members have special needs.

In professional affairs, we must:

- Press hard for truly portable pensions.
- Bring the imbalance between the supply and demand for engineers to as small a value as practical.
- Establish standards for engineering practice to assure society that an individual is competent not only today but also in the future.
- Attempt to change the customs surrounding the treatment of intellectual property of patents and copyrights developed by engineers.
- Recognize the diversity of interests and needs of the engineer within the Institute and continue to drive toward improving the position of the engineer in society.

(Continued on page 11)

(Continued from page 10)

I. Feerst

Feerst

I am delighted to present some of my views to readers of the MTT newsletter in connection with my candidacy for President of IEEE. My overall platform is well known to readers of the monthly newsletter of the Committee of Concerned EEs and it is hoped these will appear without censorship in Spectrum. I shall limit my discussion here to my belief that IEEE ought to serve as a professional advocate for its members in legal matters that are important to all EEs. IEEE has just begun to act in this fashion. They have done so with great reluctance and only after initially refusing. They have reversed their positions in response to enormous amounts of pressure exerted by Concerned EEs and others. An illustration of IEEE in this role is in order.

The San Francisco Bay Area Rapid Transit District (BART) is a system of public rapid transit. Its construction was supervised by a consortium of 4 old-line consulting engineering organizations and it was heralded as a system which would apply space-age technology to the problem of moving people. Mr. H. Hjortsvang, a Senior Member of IEEE, was employed by BART for many years. He (and others) had become concerned with the planning, execution, concept, testing, scheduling, and design of the various portions of the BART system. Their overriding concern was for the safety of the user. Of course, being an experienced engineer, Mr. Hjortsvang had written many, many memos to his superior and to his superior's superior in an effort to call to their attention the deficiencies. But nobody listened.

Finally, shortly before BART was to initiate service he and 2 others went outside the system and complained to a member of BART's Board of Directors. The resulting press conference made headlines. BART's reaction was twofold:

1. They called a press briefing to assure the public that the system was, indeed, safe.
2. They fired the 3 engineers. The 3 engineers promptly sued and requested various engineering societies to become involved.

IEEE's Board of Directors at first refused. Many of us were unhappy with this decision and did not (indeed, could not) accept this as final. We felt that it was the duty of an engineering society not only to act on behalf of its members, but to espouse the public good above all else. Happily, the persistence paid off and, on January 9, 1975, IEEE filed an *amicus curiae* brief. In it, IEEE urged the court

> "To rule . . . . that an engineer is obligated to protect the public safety, that an engineer's contract of employment includes as a matter of law, an implied term that such engineer will protect the public safety, and that a discharge of an engineer solely or in substantial part because he acted to protect the public safety constitute a breach of such implied term."

Moreover, in a subsequent statement, IEEE has affirmed that they will provide a similar legal brief for any other member in similar circumstances. Thus, an EE who refuses to ship a radar system which he feels contains an improperly operating isolator, and who faces the loss of his job for his refusal, has the knowledge that IEEE will assist him in his concern for the public safety.

The BART case ended on a mixed note. The 3 engineers settled their suit, but for only a small fraction of the original value. The BART system has been plagued with accidents, one of which was fatal.

But for the EEs, we now have the beginnings of a truly professional society. Your vote for me will ensure that IEEE will act promptly and forcefully as a professional defender for its members while, at the same time, maintaining its leadership in the technical area. The funds for this new role will be derived from the earnings of the sale of IEEE's branch building in Piscataway, N. J.

NEW BOOK

EVERYTHING YOU SHOULD KNOW ABOUT PENSION PLANS

by Fay and Leo Young

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- How does social security work ?
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VOTE

IEEE election time is here again, and I have been disappointed by the low ballot return in past years. These of course are changing times, with the engineer's standing in society and rewards both diminished from a decade ago. And the IEEE is also changing, vigorously entering into pension activities and other items concerning the economic aspects of engineering employment. With all these changes taking place, it is vital that the leadership move in directions which will best benefit and please most of the members. Your vote is important, as this is one of the best ways of steering the Institute.

R. C. Hansen
Vice Chairman, TAB

J. F. White accepting the Microwave Applications Award from Pete Rodrigue

cut

REGISTRATION

SECOND INTERNATIONAL CONFERENCE AND WINTER SCHOOL ON SUBMILLIMETER WAVES AND THEIR APPLICATIONS
San Juan, Puerto Rico, December 6 - 10, 1976

Please Print:

Name: _____
Last First Initial

University/Company: _____

Address: _____

_____ _____
City State Country

Registration includes Technical Digest.

Registration Fee	Amount
____ IEEE/OSA Member @ $60	_____
____ Non-Member @ $65	_____
____ IEEE Student @ $12	_____
____ Student @ $15	_____

Make checks payable to: SUBMILLIMETER CONFERENCE

Send registration and check to:

JAMES J. GALLAGHER
ENGINEERING EXPERIMENT STATION
GEORGIA INSTITUTE OF TECHNOLOGY
ATLANTA, GEORGIA 30332
U. S. A.

HOTEL REGISTRATION

SECOND INTERNATIONAL CONFERENCE AND WINTER SCHOOL ON SUBMILLIMETER WAVES AND THEIR APPLICATIONS
San Juan, Puerto Rico, December 6 - 10, 1976

Please Reserve:

____ Single $21.00
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+5% TAX

These special low convention rates will hold from December 3 through December 13.

If you will share a room, please indicate:

____ Specify Roommate: _____

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____ If no preference, will share with other conference attendee, assigned by Conference Committee.

Children under 12 years (in same room with parents) free.

Excellent hotel rates have been obtained for a magnificent site. Because it is difficult to assess the rapidly growing field of submillimeter technology, we may not have reserved enough rooms. Therefore, please make reservations as early as possible so that additional rooms can be requested if necessary.

Return all hotel reservations to:

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ENGINEERING EXPERIMENT STATION
GEORGIA INSTITUTE OF TECHNOLOGY
ATLANTA, GEORGIA 30332
U. S. A.

Name: _____

Address: _____

City: _____ State: _____

Country: _____

Date Arriving (Tentative): _____

Date Departing (Tentative): _____

Name(s) of other occupants _____

_____

PROPOSED BYLAWS CHANGE

PRESENT

SECTION III COMMITTEES

A. STANDING COMMITTEE

The following Standing Committees shall be appointed by the Chairman as soon as possible after his election as Chairman, and such committees shall hold office for one year co-extensive with the term of office of the Chairman except as otherwise noted in these Bylaws. It will be discretionary with the Administrative Committee Chairman to appoint any part or all of any Standing Committee, or to appoint the Chairman only of each committee and request the latter to appoint additional committee members.

4. OPERATIONS COMMITTEE

The Operations Committee shall be responsible for the operational conduct and advisory administration of the Group and the Administrative Committee. It shall be responsible for maintaining the Constitution, the Bylaws, and the Procedures Handbook; for ensuring the proper conduct of business meetings; for providing nominations for offices and awards; and for maintaining historical records.

b) Awards Subcommittee

The Chairman of the Awards Subcommittee shall hold the grade of Fellow of the IEEE. This Subcommittee shall cooperate with the IEEE in recommending members of the Group for IEEE awards, shall select for the Administrative Committee the recipient of the Microwave Prize, and shall suggest the recipient of the W. W. Hansen Award.

The Chairman of the Awards Subcommittee is empowered to submit the name(s) of candidates for any award except The Microwave Prize and the W. W. Hansen Award to IEEE Headquarters without prior approval of the Administrative Committee, but shall promptly advise the Administrative Committee of such action.

PROPOSED

SECTION III COMMITTEES

A. STANDING COMMITTEES

The following Standing Committees shall be appointed by the President as soon as possible after his election as President, and such committees shall hold office for one year co-extensive with the term of office of the President except as otherwise noted in these Bylaws. It will be discretionary with the Administrative Committee President to appoint any part or all of any Standing Committee, or to appoint the Chairman only of each committee and request the latter to appoint additional committee members.

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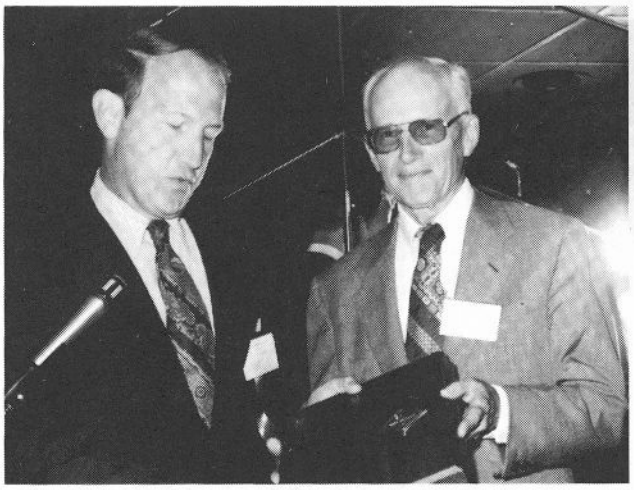
10. AWARDS COMMITTEE

The term of office of the Awards Committee Chairman shall normally begin on October 1 of the year in which he is appointed. The term of office shall normally be more than 1 year.

The Chairman of the Awards Committee shall hold the grade of Fellow of the IEEE. This Committee shall cooperate with the IEEE in recommending members of the Society for IEEE awards, shall select for the Administrative Committee the recipient of the Microwave Prize, and shall suggest the recipient of the Microwave Career and Microwave Application Awards.

The Chairman of the Awards Committee is empowered to submit to IEEE Headquarters the names of the candidates for IEEE Awards with approval of the President of the Administrative Committee.

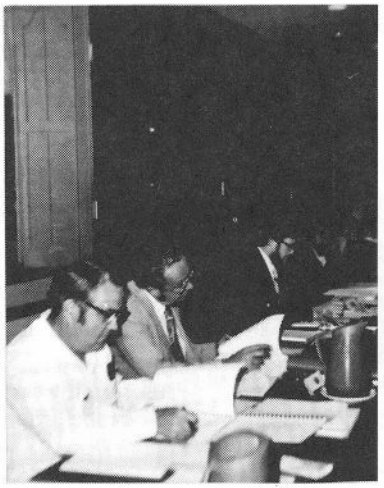


H.J. Riblet receives the Microwave Career Award from Pete

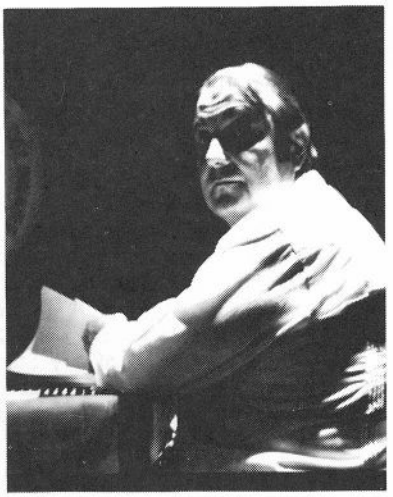
Warren Cooper received the Past President's Pin and telling all

PICTURES FROM THE ADCOM MEETING

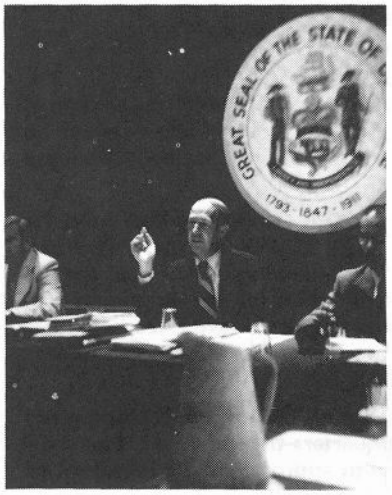
Warren Cooper telling off Charlie Rucker



The "Guys" hard at work

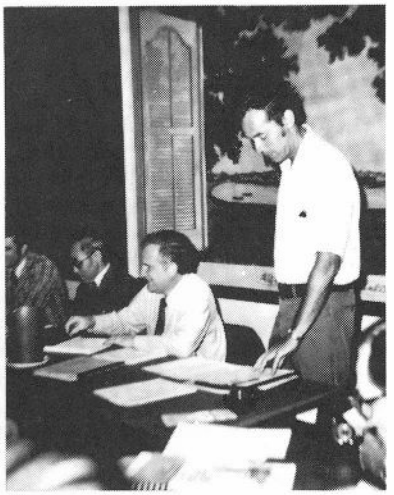


Warren Cooper's transformation into Mr. Hyde

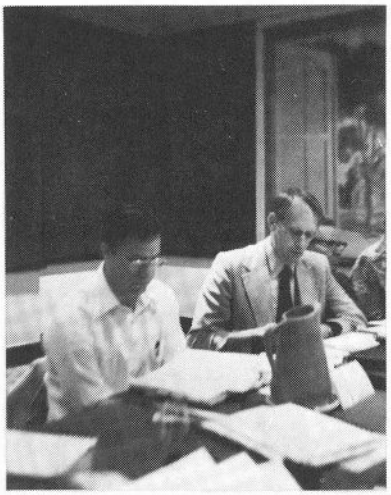


Pete Rodrigue making the major decision, "It's roast beef for lunch".

Dick Sparks in deep thought even during lunch, "What are we going to do this evening.".



Dave Rubin telling us about the great time we will have at the San Diego Symposium

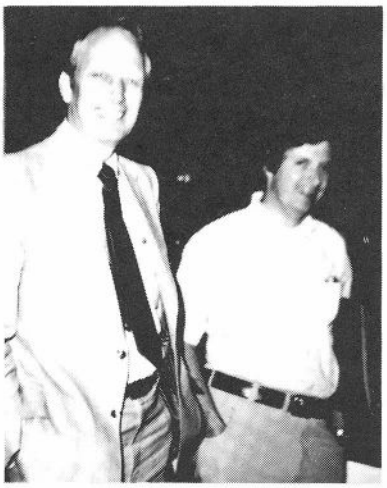


George Oltman (right) reporting on MTT Finances. No wonder he's glum !

Dick Button reporting on future Symposia. Let's have it on MARS.

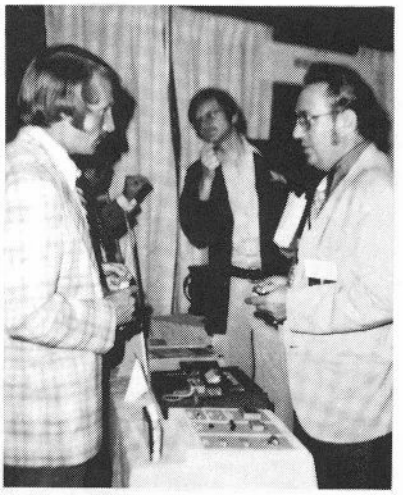
D. D. King (left) and Kiyo Tomiyasu enjoyed the ADCOM meeting

PICTURES FROM THE SYMPOSIUM

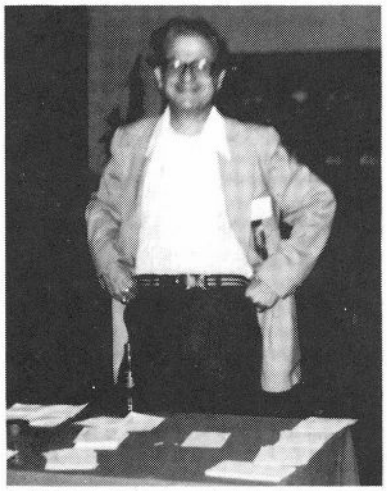


George Oltman and Fred Rosenbaum are ready for the next Symposium

Even the Social Program was great

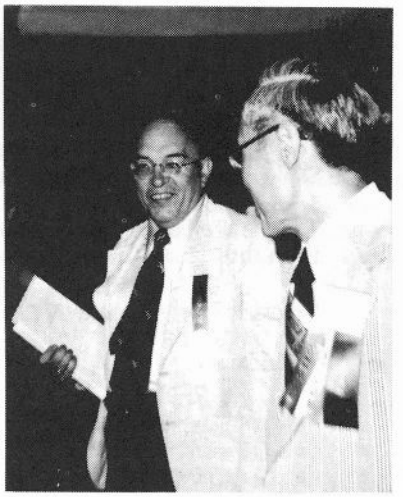


Steve Adam (right) getting an earfull

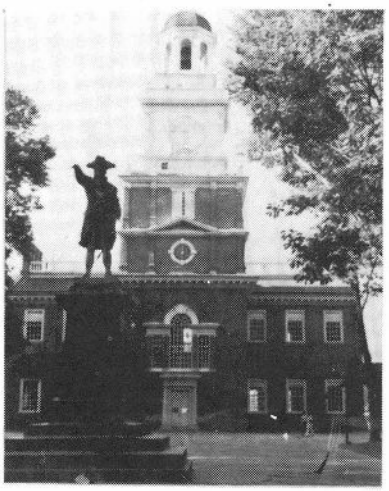


Nat Lipitz is happy with the Symposium

Jim Degenford imbibing Soda Pop ? ? ? ? ? ? ? ?

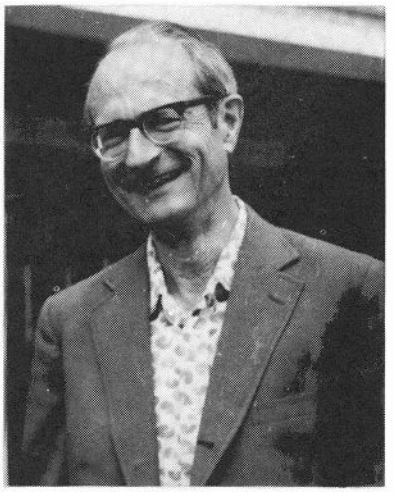


Hal Stinehelfer had a good time



Just outside Cherry Hill is Philadelphia and Independence Hall

Who told Bob Rivers (left) and Harlan Howe a very funny story



D. D. King enjoyed the Symposium

1977 International Microwave Symposium

"ACCENT ON APPLICATIONS"

THE INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS, INC.

MTT-S

21 - 23 JUNE 1977

SAN DIEGO, CALIFORNIA

FIRST CALL FOR PAPERS

The 1977 IEEE MTT-S International Microwave Symposium will be held at the Sheraton Harbor Island Hotel, San Diego, California on a beautiful site overlooking San Diego bay.

The 1977 MTT-S Symposium will feature "Accent on Applications" to help expand the horizons for Microwave use. Both tutorial and contributed papers will be utilized in appropriate areas.

Papers are solicited describing original work, not published or presented previously, which can be theoretical, technological, or applications oriented. Although any papers concerned with Microwave techniques, devices, systems and applications will be considered the following subject areas are regarded as particularly appropriate for this conference.

- Computer Oriented Microwave Practices
- Optical Techniques
- Microwave High Power
- Microwave and millimeter Wave Solid State Devices
- Microwave Biological Effects and Medical Applications
- Microwave Components and Networks
- Microwave Low Noise
- Microwave Acoustics
- Microwave Systems including Communications Systems
- Submillimeter Waves
- Microwave and Millimeter Wave Integrated Circuits
- Digital Microwave Systems
- Microwave Measurements
- Microwave Ferrites
- Microwave Field Theory

Authors are requested to submit both a 35 word abstract and a 500-1000 word summary (up to six illustrations), clearly explaining their contribution, its originality, and its relative importance. Abstracts and summaries must be received on or before January 15, 1977 by:

Dr. Gerald Schaffner
TPC 1977 MTT-S Symposium
Teledyne Ryan Aeronautical
2701 Harbor Drive
San Diego, California 92112 USA

Notices of acceptance or rejection will be mailed to authors by March 1, 1977. At that time, authors of accepted papers will receive forms and instructions for preparing material to be printed in the Symposium Digest.

SHORT COURSES

Title: **Laser Technology – Recent Advances and Applications**
Date: **September 27 – October 1, 1976**
Location: **George Washington University, Washington, D. C.**

Fee: **$ 425.00**
For further information, please write to:
Director, Continuing Engineering Education
George Washington University, Wash., D. C.
20052, or call (202) 676-6106.

Description: **This course has been designed for engineers, scientists, research personnel, and others who need a better understanding of the theory, concepts, and applications of modern laser technology. It emphasizes recent technological advances in the major laser devices and includes present capabilities, specifications, limitations, and near term prospects, along with general theory of various laser devices. Emphasis will also be on current applications of lasers in order to inform participants what is being done, what can be done, future trends, and limitations. Time will be provided for discussion of special problems and demonstrations and a tour of laser laboratories at the Naval Research Laboratory.**

Title: **Fiber and Integrated Optics**
Date: **November 1 – 5, 1976**
Location: **George Washington University, Washington, D. C.**

Fee: **$ 450.00**
For further information, please write to:
Director, Continuing Engineering Education
George Washington University, Wash., D. C.
20052, or call (202) 676-6106.

Description: **This course is designed for engineers, scientists, and managers who need a definitive and up-to-date overview of fiber integrated optics technology. Emphasis will be placed on present capabilities, recent technological advances, system analysis, and applications. The course will be structured so that the participants should acquire a solid understanding of the basic principles, theory, and techniques of fiber and integrated optical communications, as well as an appreciation for future potential applications. Attendees will receive a homework problem each day to be solved on a voluntary basis. The solution will be thoroughly discussed the following morning.**

Title: **Standards and Specifications**
Date: **November 9 – 11, 1976**
Location: **George Washington University, Washington, D. C.**

Fee: **$ 365.00**
For further information, please write to:
Director, Continuing Engineering Education
George Washington University, Wash., D. C.
20052, or call (202) 676-6106.

Description: **For those in industry and government who develop, negotiate or implement standards and specifications. These documents specify requirements for materials, components, environmental compatibility, mechanical and electrical/electronics tolerances, testing, software, reliability, safety, performance and good manufacturing practices, among others. Fundamentals and widely applicable concepts and techniques will be emphasized. Workshops will be conducted on standards and specifications for both products and systems.**

Title: **Radar Reflectivity of Land and Sea**
Date: **November 8 – 12, 1976**
Location: **Georgia Institute of Technology, Atlanta, Georgia**

Fee: **$ 375.00**
For further information, please write to:
Director, Department of Continuing Education
Georgia Institute of Technology, Atlanta, Ga
30332, or call (404) 894-2400

Description: **This course is designed for managers, scientists and engineers who need a better understanding of reflectivity data. The emphasis of the course is on a physical understanding of backscatter from land and sea, rather than the development of theory. Included in the program will be a qualitative discussion of imagery attainable with radar, followed by a brief review of basic definitions and background material. Approximately half of the lectures will be presentations on known characteristics of radar reflectivity of land and sea through summaries of a large body of experimental data. Where possible, the fundamental causes for the various observed characteristics will be outlined and interrelated. This course will be of value to radar systems engineers and those persons who apply the outputs of radar to solving problems in navigation, mapping and surveillance and to remotely determining the surface properties of land and sea.**

Title: **Principles of Modern Radar**
Date: **October 4 – 8, 1976**
Location: **Georgia Institute of Technology, Atlanta, Georgia**

Fee: **$325.00**
For further information, please write to:
Director, Department of Continuing Education
Georgia Institute of Technology, Atlanta, Ga
30332, or call (404) 894-2400

Course Outline:

I. **Radar System Fundamentals.** Definitions. Typical block diagram. Radar range equation.

II. **Radar Cross Section.** Basic derivation. Polarization scattering matrix.

III. **Propagation Effects.** Interference pattern. Attenuation and refraction.

IV. **Radar Detection Problem.** Review of probability and statistics. Detection in noise. Detection in clutter. Fluctuating targets.

V. **Elements of Radar Systems.** Antennas. Transmitters. RF amplifiers and mixers. IF amplifiers, detectors and video amplifiers. Displays.

VI. **Mechanical Aspects of Radar Design.** Fabrication methods. Tolerances. Environmental considerations.

VII. **Radar Measurements and Tracking.** Resolution and ambiguity. Range and angle tracking.

VIII. **Some Special Processing Techniques.** Log FTC. Pulse compression. Pulse doppler. Frequency agility. Polarization agility. Synthetic aperture.

IX. **ECM.** Definitions. Analysis techniques.

X. **Basic Systems Analysis Approach.** Modeling methods. Example system.

XI. **Lab Demonstrations.** Antennas. Transmitters. EM measurements. Signal processing. Radar measurements. Radar reflectivity.

EXHIBITORS AT THE SYMPOSIUM

Below is a list of exhibitors who had booths and showed their wares at the Cherry Hill Symposium. We wish to thank them for their continued support. They helped make this a successful meeting. Bert Aaron, Exhibits Chairman, deserves much credit for the success of the exhibition.

MICROWAVE EXHIBITORS

Anaren Microwave Inc.

W M Associates
- Ailtech
- Alpha
- Anzac

KDI Pyrofilm Coporation, Englemann Microwave

Frequency Sources Inc.

Eastern Instrumentation of Philadelphia
- Merrimac Industries, Inc.
- Microwave Power Devices
- Polarad Electronics Coporation
- K&L Microwave
- Acronetics, Division of Wavecom
- Wavetek Indiana
- Avantek
- Electro Rent Coporation
- EIP, Inc.

Frequency Engineering Laboratories

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Tektronix Inc.

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Gamma-F Corporation

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Com Dev Inc.

Johanson Manufacturing Corporation

VPI (Vincent Pirro Industries Inc.)
- Microlab
- Tekwave
- Keltek
- Transco
- Sonoma, Division of Wavetek

3M (Minnesota Mining and Manufacturing)

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General Microwave

RGA (Research and Development Company, Inc.)

Narda Microwave Corporation

General Electric

Compact Engineering, Inc.

Microwave Semiconductor Corporation

Hughes Aircraft Company

Plessey Electronics

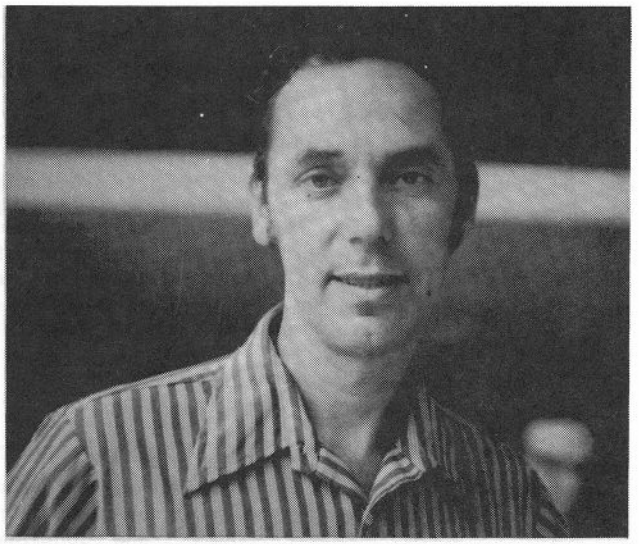
Baytron Company, Inc.

Microwave Journal

Dielectric Labs, Inc.

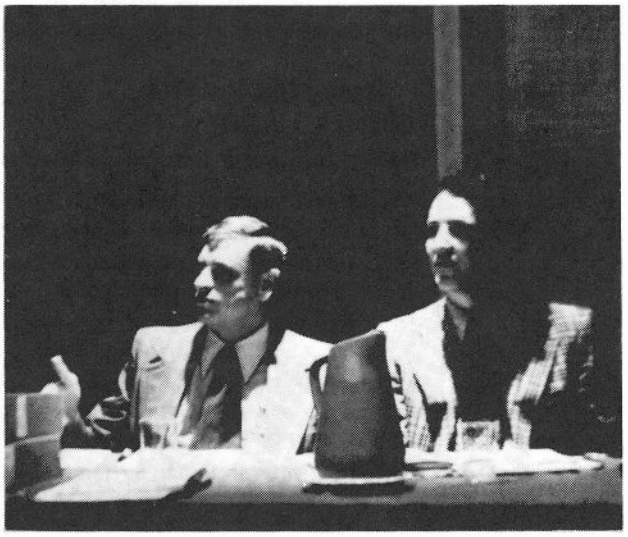
Tec-Cast

Microwave System News



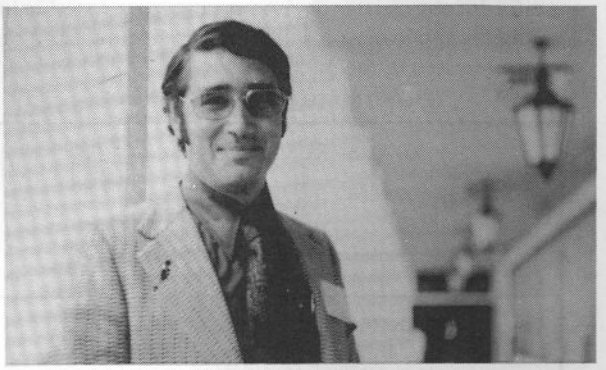
Dave Rubin when he is not engrossed in the MTT Symposium at San Diego next year

Pete Rodrigue enjoying the New Jersey sun !



Larry Whicker (left) and Lamar Allen in a hot debate at the ADCOM meeting

Dean Anderson caught between Symposium Sessions

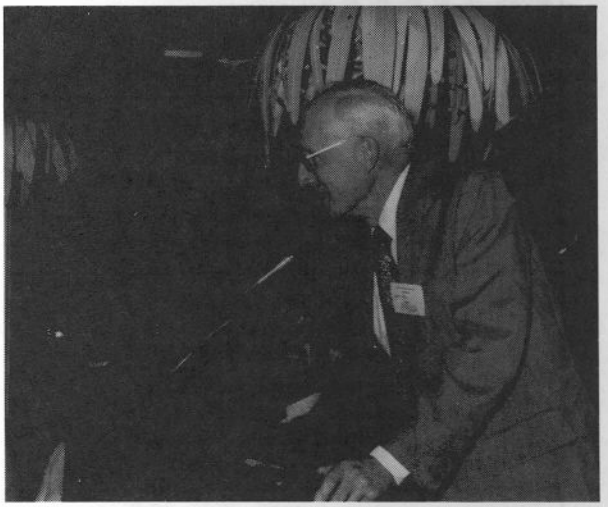


Steve Hamilton also between Sessions

Mr. and Mrs. B. D. Demarinis (left), Dr. Lenoir, and Mr. and Mrs. H. J. Riblet

J. F. White giving his Microwave Application Award acceptance speech

The Banquet, everyone had a good time



H. J. Riblet giving his Microwave Career Award acceptance speech

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